Space Weather Technical Forecast

Issued on Thursday, 15 June 2023 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1/R2 Radio Blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C6.6 at 14/2239 UTC from the plage region of ex-AR3327 in the southeast. AR3335 and AR3336 near the southwest limb are likely the most complex of the seven small and relatively simple regions on the disc, although they remain difficult to assess given their viewing angle. Further detail is expected to become apparent as they moves to a less oblique viewing angle. A small filament eruption occurred from the SW-disc around 14/1800 UTC with an associated coronal dimming, although no Earth-directed CMEs have been observed. However there are a number of other large filaments on the Earth-facing disc, with the potential to produce Earth-directed CME's if they were to erupt.

Solar Wind / Geomagnetic Activity: The solar wind at L1 remained indicative of background slow wind. Solar wind speed, as observed by ACE, remained around 350km/s, whilst the density decreased persisted below average. The total IMF, Bt was weak, remaining below 7 nT, with the north-south component varying between +6 nT and -4 nT. The phi angle was mostly positive (away from the Sun). Geomagnetic activity was mostly Quiet (Kp0-1), with an Unsettled (Kp3) interval observed at 14/0000-0300 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at background. High energy electron flux (greater than 2MeV), as observed by GOES16 was at background. The associated 24-hour fluence remained below the Active threshold (1e8 integrated pfu), with 3.43e6 integrated pfu observed at 15/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is most likely to continue, however there is a chance of this increasing to Moderate with isolated M-flares (R1/R2 Radio Blackouts).

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Solar winds are forecast to be at background to slightly elevated until the next fast wind enhancement, expected from CH12/- later on day 1 and into day 2 (15 and 16 Jun). Solar winds of around 500 km/s are forecast. Mostly Quiet geomagnetic activity at first, rising to Unsettled with Active spells with the fast wind enhancement. There is a slight chance of G1/Minor Storm intervals, mainly early on day 2 (16 Jun). Activity easing to Quiet with Unsettled intervals day 3 and 4 (17 and 18 Jun).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background. High energy electron flux (greater than 2MeV) is expected to continue at background, until after the fast wind enhancement, then likely becoming Moderate, perhaps briefly High from later day 2 onward (16 Jun). Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold, but with an increasing chance of rising above.

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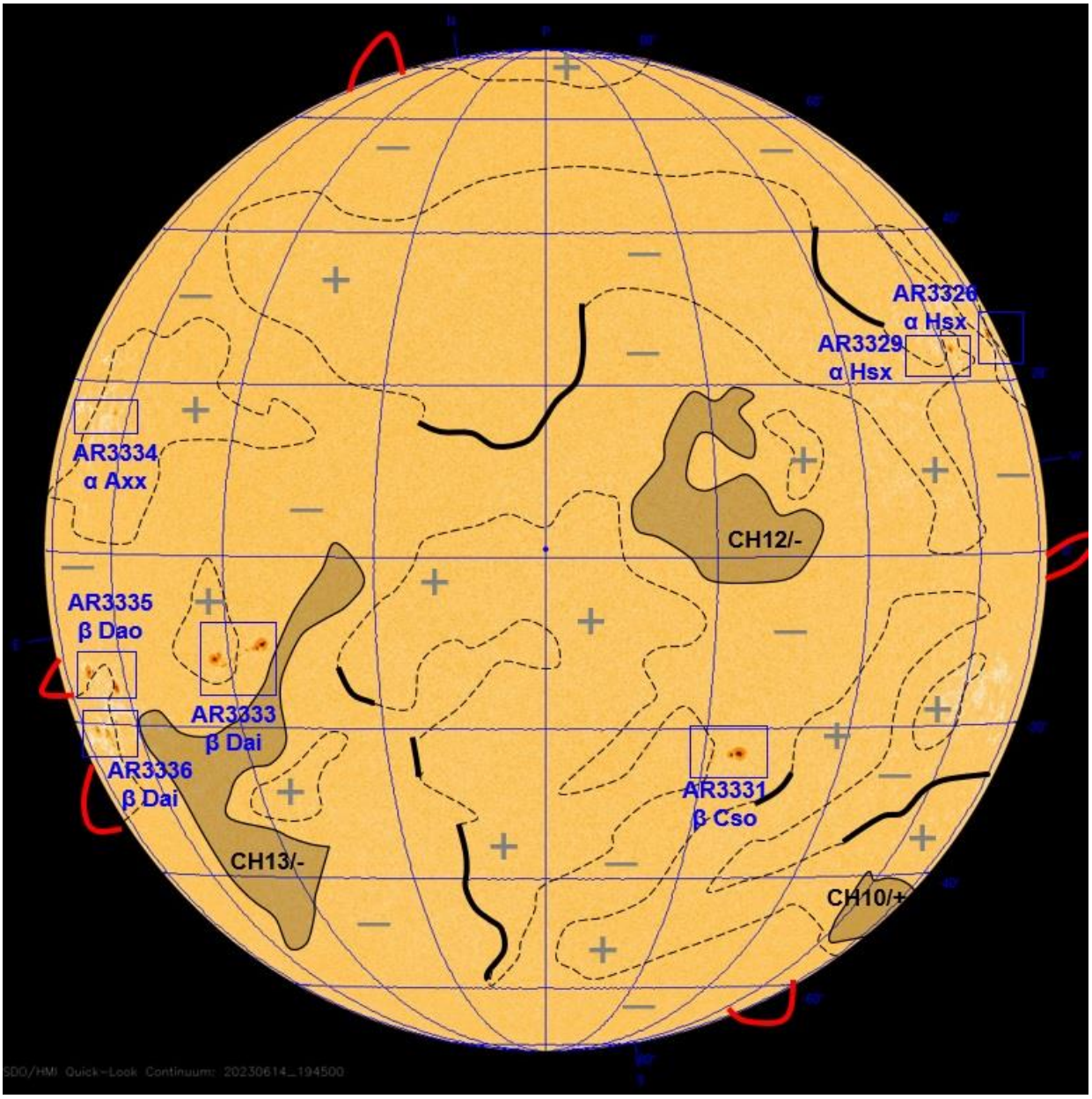
Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

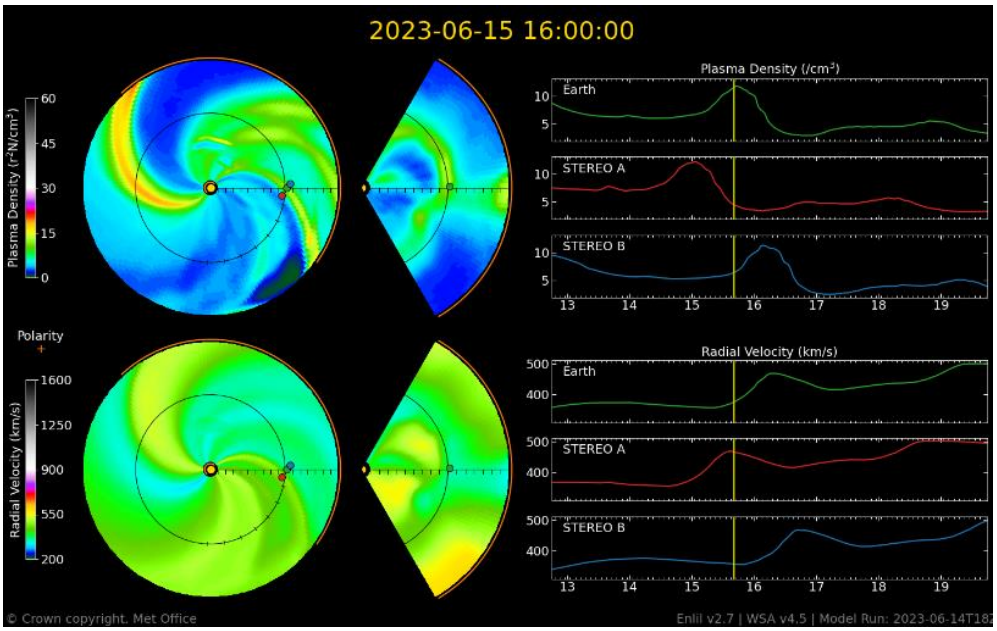
There are no Earth-directed CMEs.

Background to slightly elevated solar winds are expected until the arrival of any fast wind associated with the high speed stream (HSS) of CH12/- currently located just west of central disc. The CIR region ahead of this feature is forecast to arrive during the second half of day 1 (15 Jun), with peak solar winds likely early day 3 (16 Jun), before declining day 3 and 4 (17 and 18 Jun). 27-day persistence is currently a poor guidance due to a combination of altered CH structure, along with CME contamination on the last rotation, however Enlil is providing a good representation expected arrival times, albeit with winds below current anticipated speeds of 500 km/s.

Geomagnetic activity is forecast to be mostly Quiet, rising to Unsettled with Active spells with the fast wind enhancement. There is a chance of G1/Minor Storm intervals, mainly early on day 2 (16 Jun). Activity easing to Quiet with Unsettled intervals day 3 and 4 (17-18 Jun).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	15	20	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Enlil Model showing fast wind arrival late on 15 Jun



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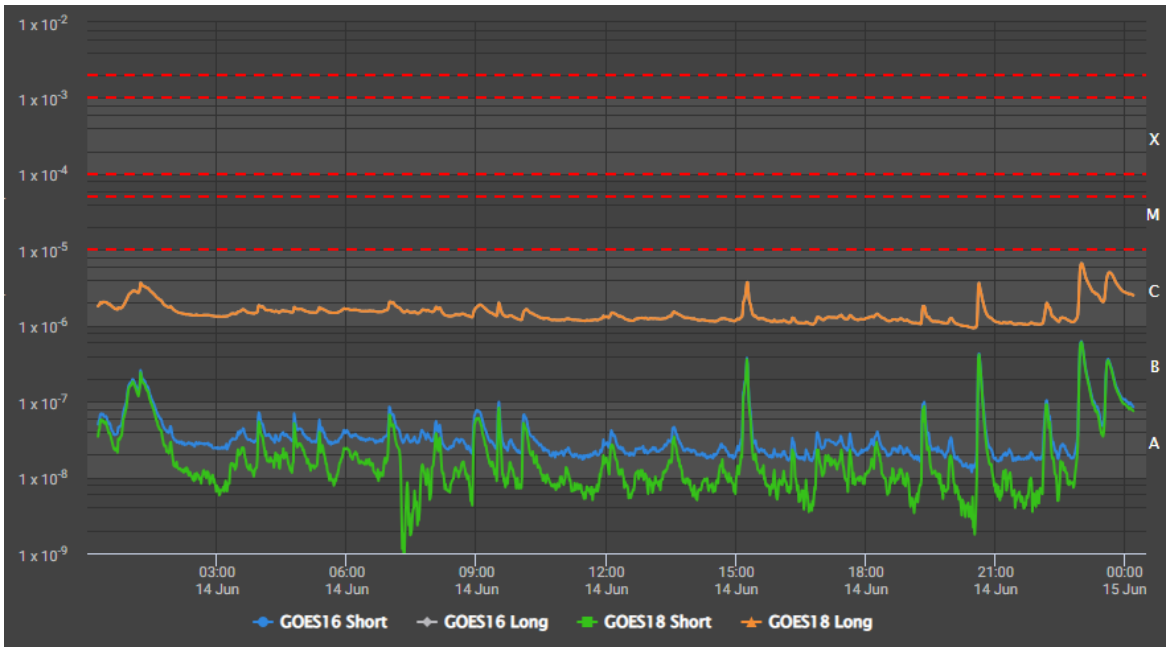
Radio Blackouts - X-Ray Flares:

Low activity is expected to continue, with a chance of M-flares.

There are seven numbered sunspot regions. The main growth phase of AR3333 appears to have stalled, and is now spreading into a simple bipolar region. This leaves AR3335 and AR3336 near the southeast limb the most complex regions currently on the disc, and the most likely source of any significant flaring, although they remain difficult to assess given their viewing angle. Magnetic looping on e.g. SDO 304 continues to suggest the potential for more complexity than is currently apparent, and this should become clearer through the next 24 hours. The other regions are smaller and simpler, however a further new region is also potentially rotating onto the NE limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: GOES-16/18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux is at Background levels and is expected to continue at this level, with only small, simple and declining sunspots currently in a geo-effective location on the Earth-facing disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to be at Background, until at least later on day 3 (16 Jun). A fast wind enhancement, currently forecast to occur late day 2 (15 Jun), may connect sufficiently to increase electron counts through the Van Allen Belts. This may then result in Moderate flux at GEO from day 3 (16 Jun), perhaps briefly High at diurnal max.

The associated 24 hr electron fluence is expected to remain steady and below the Active (1e8 integrated pfu) threshold days 1-2 (15-16 Jun), with the REFM model currently providing generally good guidance for this period. An increasing trend is then expected later day 2 and through to day 4 (16-18 Jun), but remaining below the Active threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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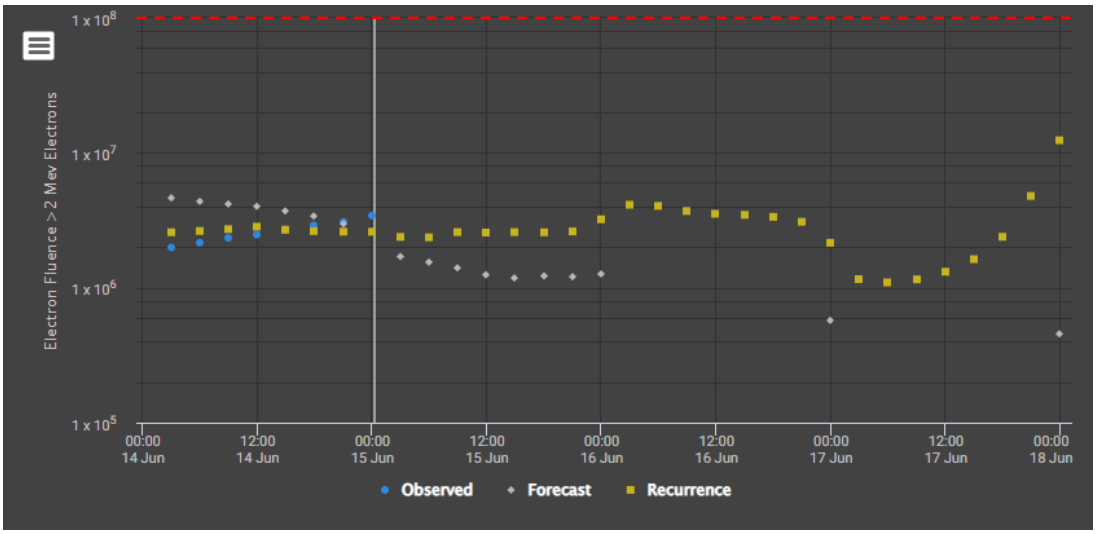
Figure 4: GOES-16 24hr >2MeV Electron Fluence and REFM with recurrence.



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